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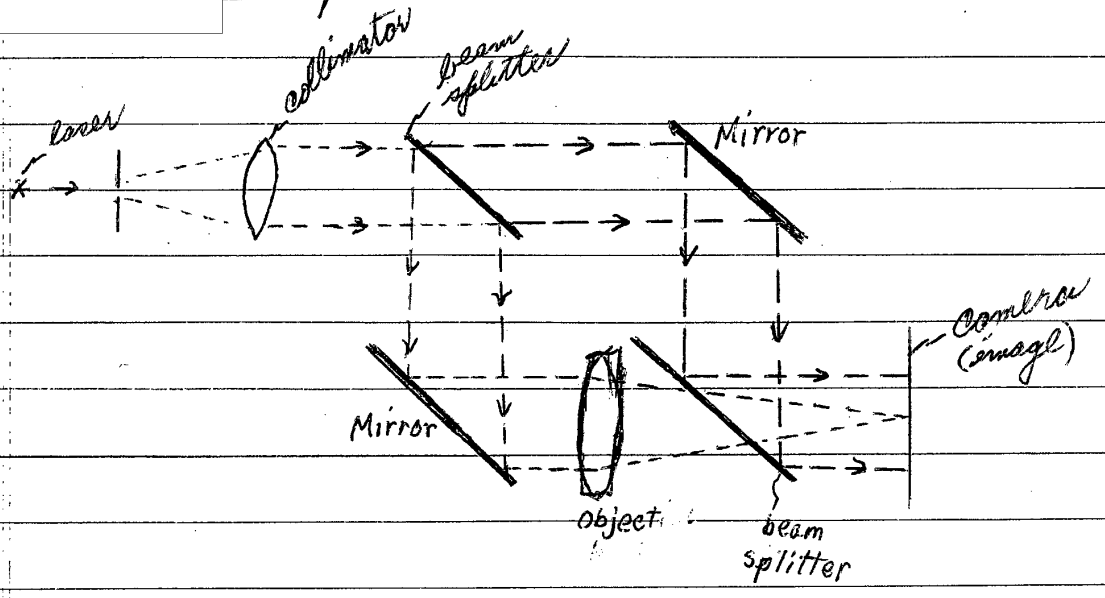
25X1

- Spatial Filtering -

9/19/66

25X1 are doing the experimental work on holograms. They are using SO 243 film with USAF bar target. 25X1 reports unstableness on the bench when making holograms (30 min exposure). A new bench on marble slab is being constructed to correct this problem. They should begin to turn out holograms on 26 Sept (approx.) They are mainly concerned with amplitude spatial filters rather than the phase filters.

25X1 Setup!



This setup is the Mach-Zehnder interferometer

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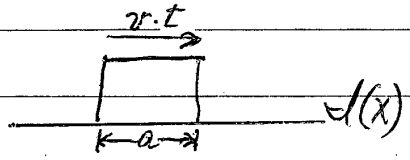
20 Sept 1966

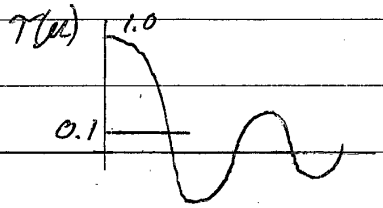
25X1

IMAGE MOTION:



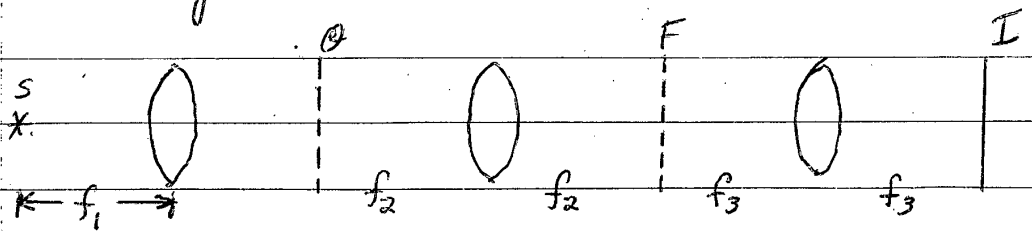
$$I_{im}(x) = I_{ob}(x) * \mathcal{A}(x)$$

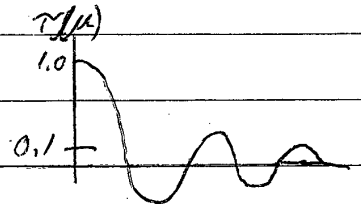
$$\tilde{I}_{im}(\mu) = \tilde{I}_{ob}(\mu) \cdot T(\mu)$$



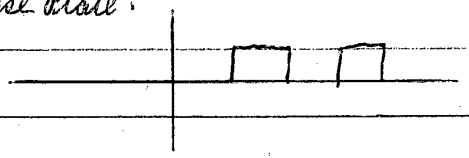
$$T(\mu) = \tilde{\mathcal{A}}(\mu)$$

2 lens setup:

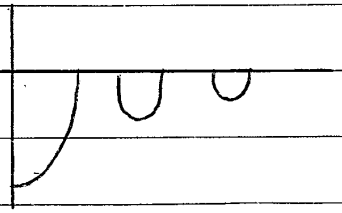




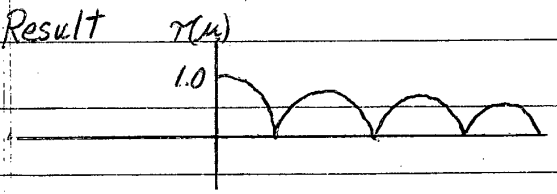
Phase Plate:



Amplitude Plate:



Result



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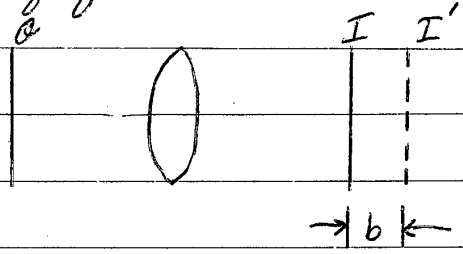
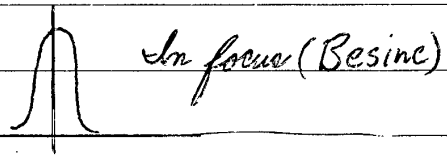
Out of focus:

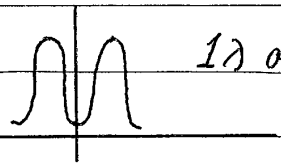


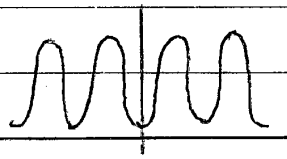
$\beta = \frac{b}{8(F\#)^2}$ = amount of out of focus (in λ)

b is expressed in number of wavelengths

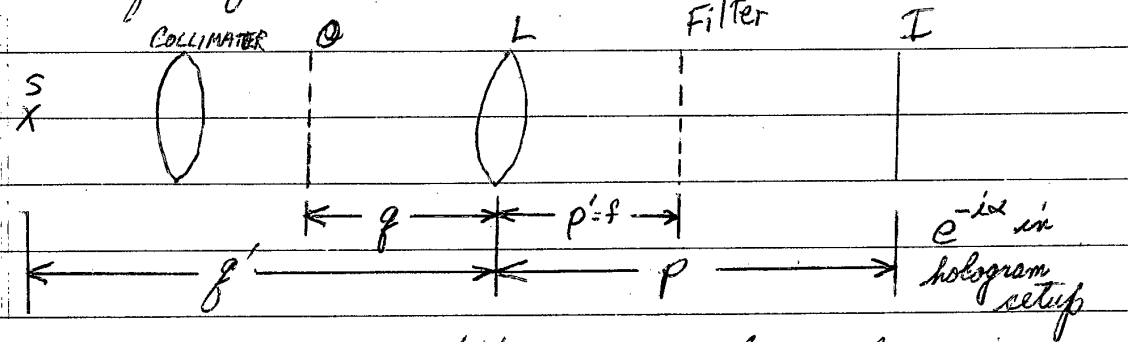
($1\lambda = 1.00\ mm$)







In the image motion problem, we are trying to construct a filter of $\frac{1}{T(u)}$ to remove the transfer function.



Source must be large distance from object plane.

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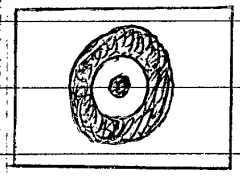
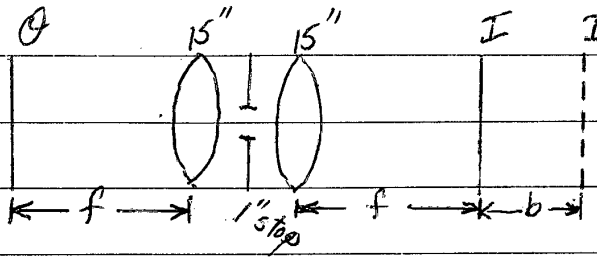
LAB WORK [redacted] 9/20/66 25X1

3λ filter ; 24 1/4" FL on filter plane lens



Lens Alignment : use alignment targets and crosshairs
Xylene – fluid gate ; same refractive index as glass.

Method for making defocussed 5λ target :



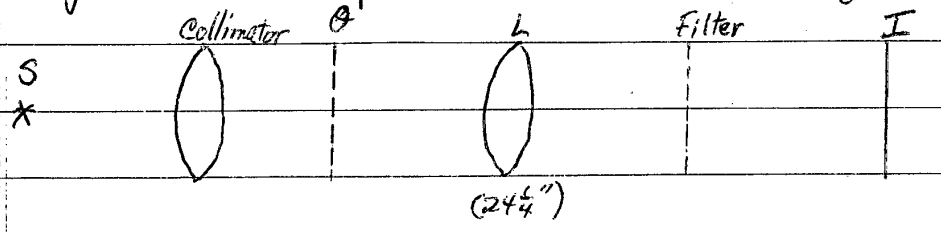
b = 4.65 mm (5λ)

2 Step Method for Defocussed target :

1.) Pan-X ($\gamma = \frac{1}{2}$)

2.) Use this film as the object and put on projective plate. Process to $\gamma = 4.00$
($4.00 \times \frac{1}{2} = \gamma, \gamma_2 = 2.00$)

Single Lens Setup of 3λ & 5λ Defocussing Plates :



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9/20/66

Spatial Filtering: [redacted] 25X1

H.H. Hopkins (1955) - Proc. Roy. Soc. A 231, 91

- [redacted] used this as reference in his quarterly report. 25X1

LINEARITY:

$I(x)$ is what we correct. Linear in amplitude.

$T_A \sim I(x)$

$T = e^{-D}$

$D = \log I(x)^{\gamma}$

$T_I = I^{-\gamma}$

$T_A = I(x)^{-\gamma/2}$, want $\gamma = -2$

Transform $\mathcal{A}(x)$:

$\tilde{\mathcal{A}}(u) = \tau(u)$

$I_{im} = I_{ob} * \mathcal{A}(x)$

$\tilde{I}_{im} = \tilde{I}_{ob} \cdot \tau(u)$

$T_I = \tau^{-2\gamma}$

$T_A = \tau^{-\gamma}$, $\gamma = 1.00$ to get $\tau(u)$.

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LAB WORK 9/21/66

Eight Situations for Photographing:

1.) IN FOCUS with IN FOCUS RESOLUTION TARGET.
2.) " " " OUT OF " " "
3.) OUT OF FOCUS (8.2mm w/r to case #1) WITH IN FOCUS TARGET AND 2 GLASS PLATES IN FILTER PLANE.
4) OUT OF FOCUS (8.2 mm) WITH OUT OF FOCUS TARGET AND 2 GLASS PLATES.
5.) IN FOCUS WITH OUT OF FOCUS TARGET AND 2 GLASS PLATES.
6) IN FOCUS WITH OUT OF FOCUS TARGET AND COMPLEX FILTERS.
7.) OUT OF FOCUS (8.2 mm) - - - COMPLEX FILTERS (5A)
8.) " " " (18.85 mm) - - - " "

Developed this film (Bon-X) in D-76 for 5 min, 68° F.
Exposure times: 1/15, 1/8, 1/4, 1/2, 1, 2, 3, 4, & 5 secs.
Saved best 6 of each (48 in all)

Could resolve to about 2-4 group using defocused bar Target as object & complex filters (#7 & #8)
In focus target when in focus yields 5-6 group.

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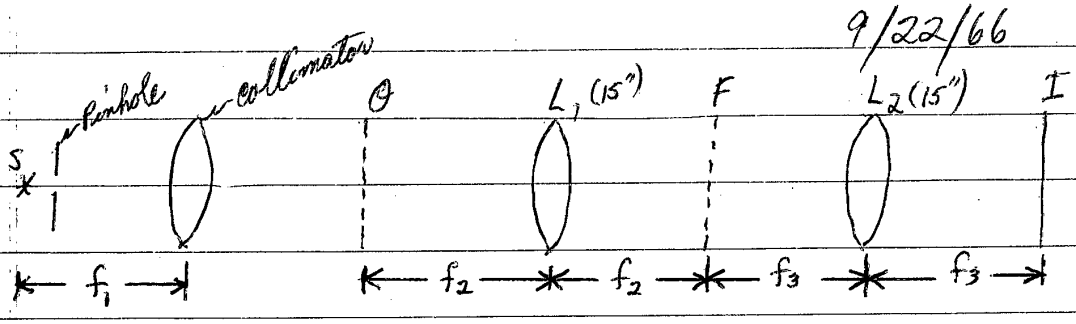
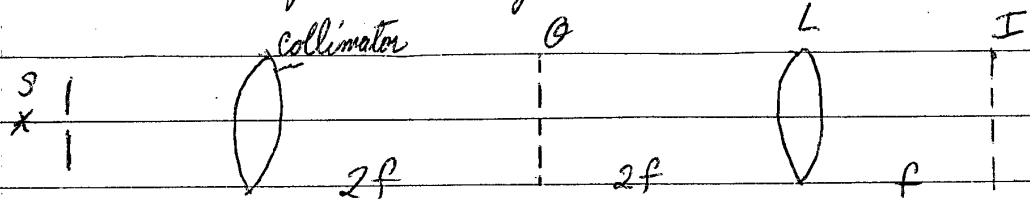
9/22/66



The lenses used at [redacted] are not the best but suffice for what work is being carried out. Also, there is a lens reflection problem. 25X1

Focussing the target with 30x and 5x eyepieces. Source is mercury arc with #58 filter.

One lens setup (3x target)



Resolves to group 3-4.

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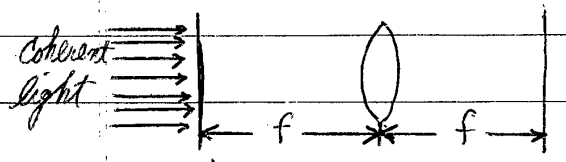
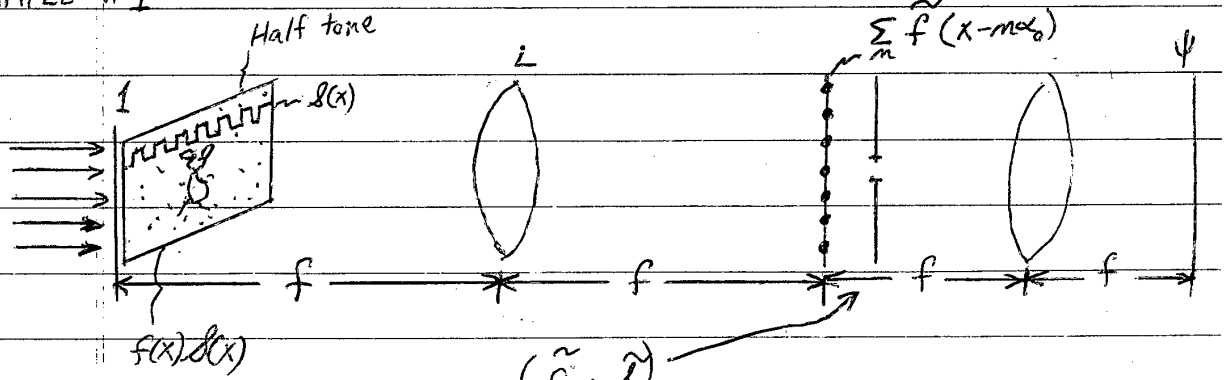
Spatial Filtering 9/22/66 25X1



$$\tilde{\psi}(\alpha) = \int_{-\infty}^{\infty} \psi(x)\, e^{2\pi i x \alpha}\, dx$$

EXAMPLE #1:



$$(\tilde{f} * \tilde{\delta})$$

$$= \int f(\sigma)\delta(\alpha-\sigma)\, d\sigma$$

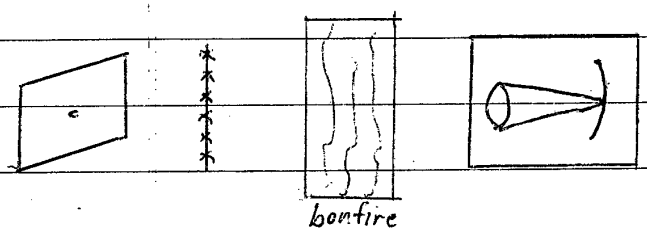
$$\psi = \int f(x) e^{2\pi i \alpha x} e^{2\pi i y \alpha}\, d\alpha\, dx \qquad (-2\alpha)$$

$$\psi = \int f(x) e^{2\pi i x(-2\alpha_0)} e^{2\pi i (x+y)}\, d\alpha\, dx$$

$$\psi = |f(y)|^2 e^{2\pi i y(-2\alpha_0)}$$

$$\mathcal{I}(\mu) = \sum_n \delta(\mu - n\mu_0)$$

EXAMPLE #2:



← assume this to be linear system.

$$I_{im}(x) = \int I_{ob}(x)\, \delta(y-x)\, dx$$

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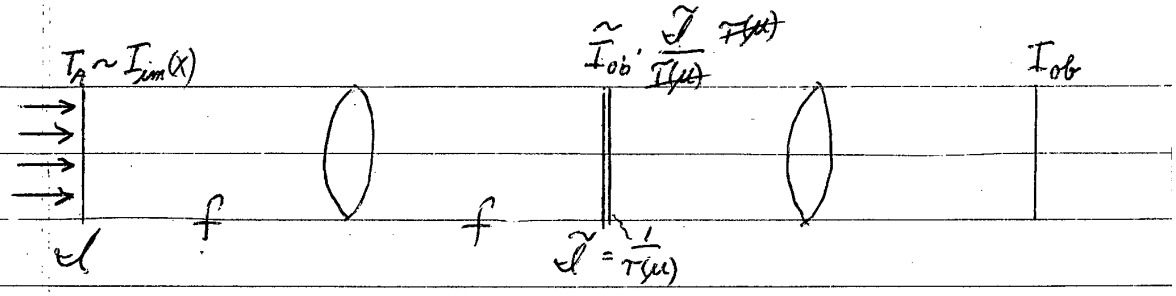
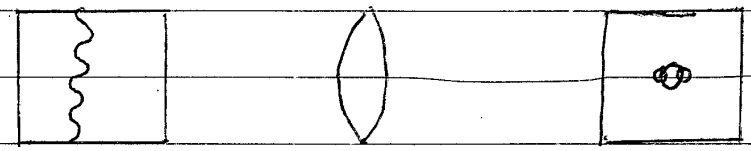
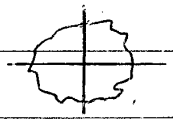
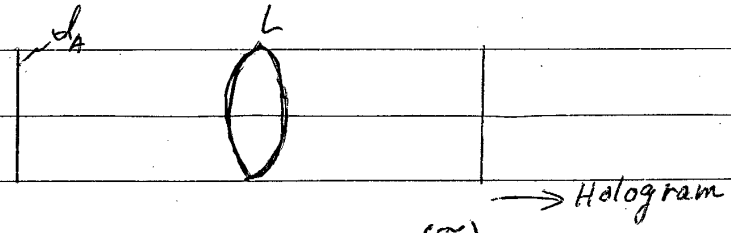






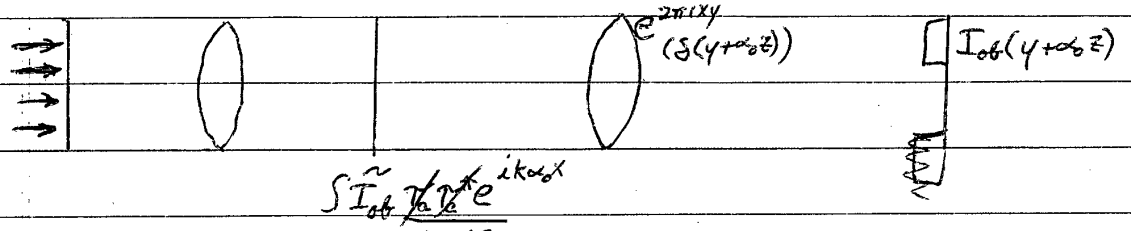
$$\int_{-\infty}^{\infty} f(x)\left(\cos xy + i \sin xy\right) dx$$

Example #3:

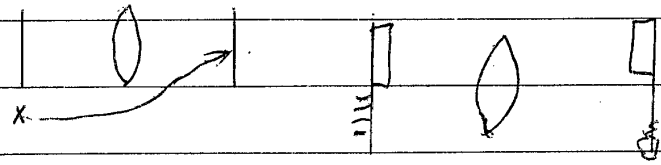


$$I(x) = \left| \tilde{J}_A + e^{ik\alpha_0 x} \right|^2 \quad (T_c)$$

$$= |T_c|^2 + 1 + T_c^* e^{ik\alpha_0 x} + T_c e^{-ik\alpha_0 x} \cdot \frac{1}{|T_c|^2}$$



Problem to do!



let f(x) be δ function

$f(x) = \delta(x - x_0)$; $\left| \tilde{f} + e^{2\pi i x_0 y} k \right|^2$

$L \sim d_{min}$ } resol.

$l \sim d_{max}$ } limits

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